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BALLAST WEIGHT FOR WASHING MACHINES

SPECIFICATION

[0001] The invention pertains to washing machines with components which are mounted with the freedom to oscillate, especially washing tubs, to which ballast bodies are attached, and also to ballast bodies for this purpose.

[0002] Because plastic washing tubs are very light in weight, they are not heavy enough to ensure the proper operation of the washing machine in washing machines with modern oscillating systems. For this reason, the washing tubs are weighted with ballast weights.

[0003] EP 0 825 291 A1 describes a disk-shaped, approximately circular weight, which is attached to the bottom of the washing tub. The weight is made of an unspecified mixture of materials, presumably concrete, with a density of > 2 g/cm^3. It rests on three contact surfaces on a plane parallel to the main plane of the bottom and is held by brackets, which are spaced equal distances apart around a circle and which extend in a direction perpendicular to the main plane. They are kept tightly pressed against the narrow edge of the weight by a tensioning strap, which encircles them externally

[0004] A concrete weight which serves as a loading weight and which is attached to the washing tub by a tensioning strap is also described in DE 32 17 160 A1. In this case, an outer metal tire is cast into the loading weight.

[0005] These types of tensioning rings around concrete parts suffer from several disadvantages. Thin concrete breaks easily, especially in the environment present here with wide temperature variations; and under the otherwise clean conditions in which "white goods" are manufactured, concrete weights also represent a contamination of the production line.

[0006] The dimensional accuracy of weights of this type and of their fastening points to washing tubs is not very high, nor is there much freedom in designing them. Tensioning straps are difficult to work with during the course of repairs, and their functional reliability cannot always be guaranteed. It is difficult to automate the fabrication of these ballast weights and the

work of fastening them to the tubs.

[0007] Loading weights of heavy, nonmetallic concrete with openings which are complementary to frustum-shaped screw tubes attached to the bottom of the washing tub are known from DE 42 38 686 C1 and DE 42 38 685 A1. Screws introduced from the surface of the loading weight pull spring plates far into the openings on one side, and on the other side they also pull the screw tubes, made of thermoplastic material, into the openings from the bottom. According to the recommendation in the former EP document, the tension should be great enough that, in spite of the relaxation natural to thermoplastic material, sufficient tensioning force will still be present even at the end of the unit's service life. Aside from the difficulty of applying the precise tightening torques required in these difficult-to-access areas, the selected thermoplastic apparently cannot be made homogeneous enough in practice to meet the requirements imposed on these types of screw joints in washing machines.

[0008] For other reasons, DE 38 34 112 A1 proposes that the upper part of the plastic tub be made hollow and that it be provided with an opening, through which a pourable bulk material, preferably scrap iron of a sand-like or coarsely granular consistency, can be added. These mass particles are first coated in a separate process with a heat-insulating plastic layer, which is intended to provide a layer of insulation against the walls of the tub, so that this weight-equalizing mass will not remove any heat from the washing liquor.

[0009] A process for producing a washing machine ballast weight which consists of a hollow body of plastic, which is filled with a special, heavy, inert material, is known from EP 0 812 946 A2. The hollow body is designed as a ring-shaped ballast element, the shape of which conforms to that of the washing tub. The method by which the weight is attached to the tub is not disclosed.

[0010] A similar system is described in EP 0 969 134 A1, where the counterweight , namely, a hollow body filled with concrete, has openings for screws, which fasten the ring-shaped ballast weight to the washing tub.

[0011] EP 0 798 412 A2 also describes a concrete-filled body with openings, into which a partly nonpositive, partly positive connector similar to an expansion anchor can be inserted. Screws can be screwed into these anchors to fasten the ballast weight to the washing machine.

[0012] EP 0 307 282 B1 describes a ballast weight for the end surfaces of a washing machine tub with a washing drum which rotates around a horizontal axis. This weight consists of concrete or an agglomerate, especially a metal-plastic agglomerate, and has a convex surface at least on the external side. On the internal side facing the tub, surfaces are provided which are complementary in form to that of the corresponding end surface of the tub, thus making it possible for the weight to be attached stably to tub.

[0013] These are individual weights, which are attached segment by segment to the tub and which therefore cannot be easily balanced either with respect to each other or with respect to the tub. Although a metal-plastic agglomerate is mentioned, it is impossible to identify the materials out of which the agglomerate should be made or the form which it should take.

[0014] Finally, a washing machine with components for attaching weighting bodies and the weighting bodies themselves are known from EP 0 417 460 A2. These weights are made out of reaction resin concrete (concrete polymer) containing thermosetting materials. It is also mentioned that the weight of the component can be increased by the incorporation of denser additives such as iron scrap. Thus various densities, that is, various weights, can be produced for different applications. The production times and costs of components such as this are high when they are mass produced, because temperature-dependent pot lives and final curing times must be taken into account.

[0015] Proceeding from this state of the art, the invention is based on the problem of designing a ballast weight as a rigid, fracture-resistant molded part in the shape of a ring, which can be easily attached to a washing tub; on the problem of producing these types of molded parts easily in a separate operation while ensuring at the same time that they have a long service life; and on the problem of overcoming the disadvantages, known from the state of the art, of thermoplastic materials.

[0016] These problems are solved according to the invention by the features of Claims 1 and 7. Elaborations of the invention are addressed in the subclaims.

[0017] For washing machines with components which are supported with the freedom to oscillate, especially washing tubs, to which ballast bodies, preferably those containing a certain amount of plastic and a certain amount of ferrous material, are attached, the solution provides,

first, that the ballast body has approximately the shape of a ring or of a section of a circular ring of optional cross-sectional thickness, and that, in at least one circular arc, several openings and/or holes are provided, the surfaces of which are complementary to the corresponding external contours of fastening elements on the component. The fastening elements on the component and the surface of the ballast body should consist essentially of thermoplastic material and should, in a plane more-or-less parallel to the surface of the ballast body, have a honeycomb structure or a closed outside contour with stiffening webs in between.

[0018] As a result, the ballast body can rest simultaneously against the outside contours of a plurality of fastening elements, which minimizes the load exerted by the ballast bodies on the component. This measure is especially effective when the outside contours are oval or kidney-shaped. As a result, the ballast body can rest simultaneously against the outside contours of a plurality of fastening elements, which minimizes the load exerted by the ballast bodies on the component. Other shapes are also possible, however, for the external contours or for the rib structure of the fastening elements in particular, as long as the principle of the invention is still followed.

[0019] The inventors conducted a large number of studies and calculations based on the finite-element method and found that some of the openings will always be in engagement with the fastening elements of, for example, the appropriately designed front section of a washing tub. That is, the creep behavior typical of thermoplastics such as polyethylene or of the preferred polypropylene as seen in the creep test at temperatures typical for washing machines under both static and dynamic loads has hardly any disadvantageous effect. The fastening structures, when of the ribbed type, are designed with an appropriate safety factor sufficient to prevent fatigue fractures. Because the screw joints for fastening the ballast body are operative here in addition to the external contours of the fastening element, there is a higher degree of security in comparison with the state of the art with respect to the correct, permanent seating of the ballast body. In addition, some of the fastening elements are selected to serve only as guides for the ballast body.

[0020] According to additional aspects of the solution, a ballast body for washing machines, especially a ballast body to be fastened to washing tubs, is produced by injection

molding from a mixture of plastic material and ferrous material and has a density of > 2.4 g/cm^3. It consists, namely, of a thermoplastic filled with a significant amount of hematite and/or magnetite.

[0021] After the plastication of the thermoplastic in an extruder, a metal component, preferably a pure ore of hematite or magnetite or mixtures of the two with the smallest possible grain size, i.e., small enough not to interfere with the extrusion or injection-molding process, is then added to the extruder before the extrusion or injection-molding or press-molding. In view of the fact that the ballast bodies have relatively large cross sections, even quite granular metal components can be used. Experiments have shown that rolling scale, which contains certain amounts of FeO and impurities in addition to Fe_2O_3 and Fe_3O_4, can also be used, but the pure ores are preferred.

[0022] Whereas thermoplastics have a specific gravity or density of 0.9-1.0 g/cm^3, hematite and magnetite have a density of approximately 5.2-5.3 g/cm^3. They, too, like pure washed ores, are easy to handle and do not generate any dust and therefore can be used directly in the injection-molding or extrusion process. The metal components are completely surrounded by the thermoplastic material, so that, according to this method, a completely homogeneous body with a plastic surface is obtained. To achieve a specific gravity or density of > 2.4 g/cm^3, the hematite portion or the magnetite portion or the mixture of the two should make up 35-70% of the volume of the body, which leads to a specific gravity which, according to the experiments conducted by the inventors, should be in the range of 2.5-3.9 g/cm^3, and preferably 2.9-3.5 g/cm^3. In terms of the amount of added metal component, this is a compromise to ensure good processability in, for example, an extruder with an appropriate die, which has been custom-made to suit the dimensions of the ballast body.

[0023] The invention is to be described in greater detail below on the basis of a diagrammatic illustration of an exemplary embodiment:

Figure 1 shows an overall view of a model of a washing tub and a ballast weight;

Figure 2 shows the contour of a washing tub according to Figure 1;

Figure 3 shows the contour of a ballast weight according to Figure 1; and

Figure 4 shows a cross section of a ballast weight seated on a fastening element of

the washing tub according to Figure 1.

[0024] A washing tub 2 of a front-loading washing machine with a front-loading opening 21 is equipped with a ballast weight 1, which extends around this front opening. So that the weight and the adjacent components of the washing machine can be balanced, the weight 1 has various recesses 15. From the top surface, the weight can be connected to the washing tub 2 by the use of appropriate openings 13.

[0025] Figure 2 shows a perspective view of a washing tub similar to that of Figure 1, except that the weight 1 has been removed. A row of fastening elements 23, 24 is arranged around the front-loading opening 21 on the end surface 22 of the washing tub 2. The fastening elements 23 are also equipped with posts 233, into which connectors passing through the weight can be inserted. In this case, a total of eight fastening elements is shown, including four fastening elements 23 with means for accepting connectors and four fastening elements 24 without means for accepting connectors for the attachment of the weight 1.

[0026] It is not necessary to use eight fastening elements in all cases. A different number of fastening elements 23, 24 can be used to deal with different load situations created by the ballast weight 1 and/or by the centrifugal speed of the washing machine and/or by other loads. The kidney-shaped or oval fastening elements shown here could also be replaced by round or polygonal elements.

[0027] The external contours 232, 242 of the fastening elements 23, 24 both lie on circles, that is, on an outer circle closer to the outside surface of the washing tub and on an inner circle closer to the front-loading opening 21. As a result, the ballast weight 1 exerts its load uniformly on the tub. The principle of the invention is that the openings or holes in the ballast weight are complementary to the external contours, and that the surfaces of these openings or holes rest fully against the external contours 232 as a result of which most of the load is applied to the external contours 232 of the fastening elements. A necessary positive connection between the ballast weight 1 and the washing tub 2 can then be distributed over a few threaded posts 233.

[0028] It is easy to see the ribbed or honeycomb structure of the fastening elements. A calculation of the force vectors has shown that a structure of this type ensures optimal conditions for the transmission of the observed torques and loads without causing any difficulties with

respect to the injection-molding process.

[0029] The washing tub is preferably made of a plastic such as polyethylene or polypropylene, so that both the washing tub and the loading weight, which is shown by itself in Figure 3, preferably have similar surfaces.

[0030] Figure 3 shows the bottom surface of the ballast weight according to Figure 1, i.e., the side facing the washing tub.

[0031] In contrast to the washing tub, the recesses in the ballast weight are of different shapes. Common to all the recesses 11, 11', 11" is that their surface 111, which serves as a contact surface for the external contours 232 of the fastening elements, are all of the same design in order to ensure the most homogeneous possible contact with the external contours 232, 242 of the fastening elements 23, 24. Depending on how many fastening elements 23, 24 with corresponding external contours 232, 242 are present, the same number of recesses 11, 11', 11" will be provided in the ballast weight 1. As already mentioned, the ballast weight has recesses 15 in consideration of the center of gravity of the washing tub and of the loading weight and in consideration of other components of the washing machine. To compensate for the weight in the area of the recesses 15 shown in Figure 3, it is provided that the loading weight also has elevations 14 inside the recesses, which can fit into the empty spaces in the fastening elements 23, 24 and thus increase the local weight of the ballast.

[0032] Figure 4 shows a cross section through the ballast weight of Figure 1 in the area of a fastening element 23 with a threaded post 233. The weight 1, as already shown in Figure 1, has an upper depression 12, 13 to allow a fastening means to be inserted into the threaded post 233. The weight 1 rests on the surface 22 of the washing tub 2, next to the front-loading opening 21, but the surfaces 111 of the weight are also in contact with the external contours 232, 242 of the fastening elements 23, 24. The honeycomb or ribbed structures 241 of the fastening elements are especially easy to see here. In the case of fastening element 24, these structures provide the external contour 242 with appropriate support, whereas the structures 231 provide the external contour 232 with similar support.

[0033] As previously described, the weight also has elevations 14 in some of the fastening elements 23. These elevations are used to adjust the position of the center of gravity.

Although they fit into the fastening elements 23, they do not make contact with them, just as the threaded posts 233 do not make contact with the weight.